

तेल दाब स्टोव और तेल दाब हीटर  
के लिए बर्नर — विशिष्टि

( तीसरा पुनरीक्षण )

**Burners for Oil Pressure Stoves  
and Oil Pressure Heaters —  
Specification**

( *Third Revision* )

ICS 27.060.10; 97.040.20

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## FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Oil Burning Appliances Sectional Committee had been approved by the Mechanical Engineering Divisional Council.

The burner is a vital component of an oil pressure stove. In view of large number of manufacturers engaged in making burners only, it has been considered expedient to have a separate standard for burners, which will facilitate the manufacturers to make use of ISI Mark for this component.

This standard was first published in 1978 and subsequently revised in 1986 and 1999. This revision of the standard has been brought out to incorporate the Amendments No. 1, 2, 3 and 4 issued to the standard and to take into account the fast changing manufacturing and trade practices followed in the country.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

## Indian Standard

# BURNERS FOR OIL PRESSURE STOVES AND OIL PRESSURE HEATERS — SPECIFICATION

*(Third Revision)*

## 1 SCOPE

This standard specifies dimensions, performance and other general requirements of burners for oil pressure stoves and oil pressure heaters.

## 2 REFERENCES

The standards given in Annex A contain provisions, which through reference in this text, constitute provisions to this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the

possibility of applying the most recent editions of the standards listed in Annex A.

## 3 TERMINOLOGY

For the purpose of this standard, the nomenclature of different types of burners and their components shall be as indicated in Fig. 1 to 7.

## 4 TYPES

The burners shall be of the following types commensurate with the designation of stoves along with which they are meant for use:

Sl No.	Burner Type	Oil Pressure Stove		Oil Pressure Heaters	
		Stove Designation New	Burner Designation	Heater Designation	Burner Designation
(1)	(2)	(3)	(4)	(5)	(6)
i)	Roarer type	OOR, OTR, OR, 1R, ILR, 2R and 3R	0, 1, 2, 3	As per IS 2787 for 1 and Multi burners	1H, 2H, 3H, and 4H
ii)	Silencer type	OOS, OTS, IS, ILS, 2S, 3S	OS, 1S, 2S, 3S	—	—
iii)	Tube type	OTR, OTS	O, OS	—	—

## 5 MATERIALS

The components of the burners shall be made from materials as indicated below against each:

Sl No.	Type of Burner	Component	Ref to Figures	Material	Recommended Specification
					Ref to IS No.
(1)	(2)	(3)	(4)	(5)	(6)
i)	Roarer type burner	Top portion	1	Leaded brass or Brass suitable for forging or MS Sheet	319 6912 1079/513
		Burner ring	1	Brass sheet or MS sheet	410 1079/513
		Nipple	2	Brass rod	319
ii)	Silencer type burner	Inner and outer cap	3B and 3C	Heat resisting steel or brass sheet of 0.90 ± 0.05 mm thick or Mild steel	1570 (Part 5)/410/1079/513
		Burner fuel feed pipe	1 and 3A	Seamless brass/Copper tubes Copper brazed steel tube	407/2501/8119

Sl No.	Type of Burner	Component	Ref to Figures	Material	Recommended Specification
					Ref to IS No.
(1)	(2)	(3)	(4)	(5)	(6)
iii)	Tube type burner	Burner tube	4	Nickel silver sheet	2283
		Burner head	6	a) Top portion brass sheet $1.60 \pm 0.05$ mm thickness  b) Lower portion cast brass or Wrought brass	410  292 410
		Burner plate	5	Grey cast iron	210
		Silencer cap (outer and inner)	7	Heat resisting sheet or Brass sheet of $0.90 \pm 0.05$ mm thick or Mild steel	1570 (Part 5)/ 410/1079/513
		Wire cloth	4	Brass wire cloth $0.25 \times 0.180$ mm	1568

## NOTES

1 Minimum copper content for brass items is 60 percent.

2 The Indian Standards referred in col 6 are for guidance only.

## 6 SHAPE, SIZES AND DIMENSIONS

**6.1** Figure 1A, 1B and 2 show the common shape, sizes and dimensions of roarer type burner and its important components.

**6.2** Figure 3A shows the common shape, sizes and dimensions of silencer type burner and Fig. 3B and 3C show the dimensions of inner cap and outer cap of the silencer type burner.

**6.3** Figure 4 to 7 show the common shape and dimensions of tube type burner and its important components.

**6.3.1** The brass wire cloth provided in the tube type burner shall be closely rolled to form a cylinder. Length and width of the strip of brass wire cloth shall be 150 mm and 40 mm respectively.

**6.4** Maximum permissible reduction in sheet thickness of various components of burners shall be as follows:

Sl No.	Component	Maximum Permissible Reduction in Thickness (mm)
(1)	(2)	(3)
i)	Outer cap for silencer type burner	0.12
ii)	Burner head (top portion) for tube type burner	0.15

## 7 CONSTRUCTION AND ASSEMBLY

**7.1** All burner joints shall be soundly brazed with any suitable brazing alloy having a high melting point (750 to 800°C). The brazed Joints shall be sound and smooth and shall be free from cracks and other defects likely to affect the normal functioning of the burners.

**7.2** On assembling with the fuel container the burner shall be concentric with it. The assembly of the burner shall be such that the fuel jet plays centrally and vertically to the burner plate or burner top so as to produce a uniform, well spread blue flame. These screw threads at the base of the burner shall be clean and properly formed and shall be of sufficient length so as to provide a leak-proof assembly with the fuel container.

**7.3** In the case of silencer burner, the outer cap of the burner may have five rows of holes equally spaced so that the flame burns without a hissing noise. The outer cap and inner cap of a silencer burner may be either separate or of composite type. In case of tube burner with silencer arrangement, provision shall be made for locking the silencer cap to the burner head.

**7.4** Sufficient opening shall be provided in the burner assembly to allow free access to the pricker to the fuel orifice and for screwing and unscrewing the nipple.

**7.5** The orifice for the fuel in the nipple as well as in the tube type burner shall be drilled straight and shall be free from burrs. The mouth of the orifice shall be so shaped as to facilitate the use of the pricker for cleaning.

### 7.6 Washer

The washer shall be resistant to heat and kerosene oil and it shall be capable of giving leak-proof seal.

### 7.7 Interchangeable Parts

The burner as well as its following components shall be interchangeable in the same type of stove:

- a) Nipple
- b) Burner plate
- c) Burner head } For tube type burner

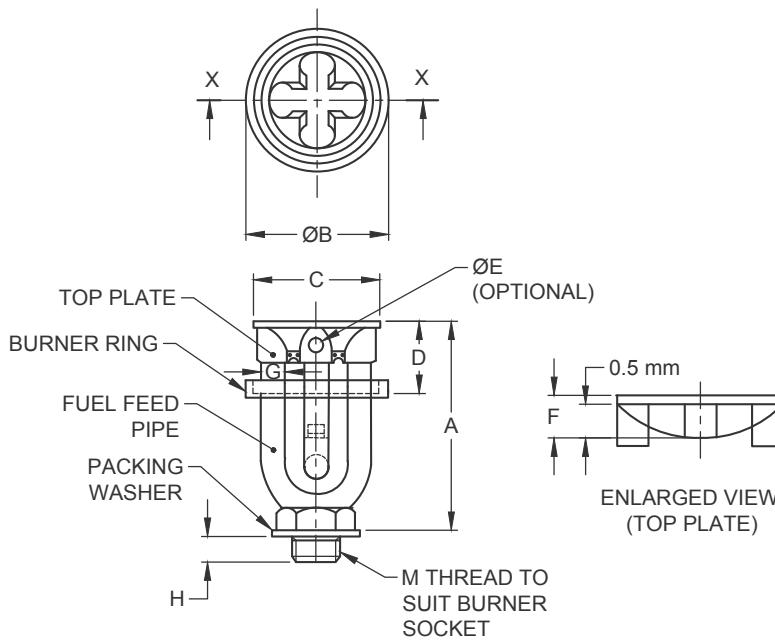


FIG. 1A BURNER, ROARER TYPE TYPICAL

Sl No.	Stove Designation		Burner Designation	Dimensions				E Hole Dia (Optional)	F	Thread (Medium Fit)	Diameter <sup>1)</sup> of Fuel Feed Pipe	Thickness of Burner Ring	Thickness of Fuel Feed Pipe	Dimensions of Hex Across Fiats	Mass of Burner
	New Designation	Existing Designation		A	B	C	D								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
i)	0 and 1	1 and 101	0 and 1	60	44	38	$21.0 \pm 1$	4.5	9	M14.5 × 0.75	$8.0 \pm 0.08$	0.75	$0.8 \pm 0.10$	19.0	90
ii)	2	2	2	73	55	45	$23.0 \pm 1$	5.5	11	M14.5 × 0.75	$9.0 \pm 0.08$	0.95	$1.0 \pm 0.12$	19.0	135
iii)	3	3	3	100	73	58	$32.0 \pm 1.5$	6.0	16	M17 × 1.00	$10.0 \pm 0.1$	1.00	$1.14 \pm 0.15$	22.0	270
iv)			4	120	85	68	$47.0 \pm 2$	6.5	19	M17 × 1.00	$11.0 \pm 0.1$	1.12	$1.14 \pm 0.15$	22.0	425

NOTES

1 Other designs also permissible subject to no change in dimensions A, B and hexagonal nut.

2 Copper brazed steel tubing as per IS 8119 is also permitted.

<sup>1)</sup> Refer to IS 5493 for details

All dimensions in millimetres unless otherwise specified

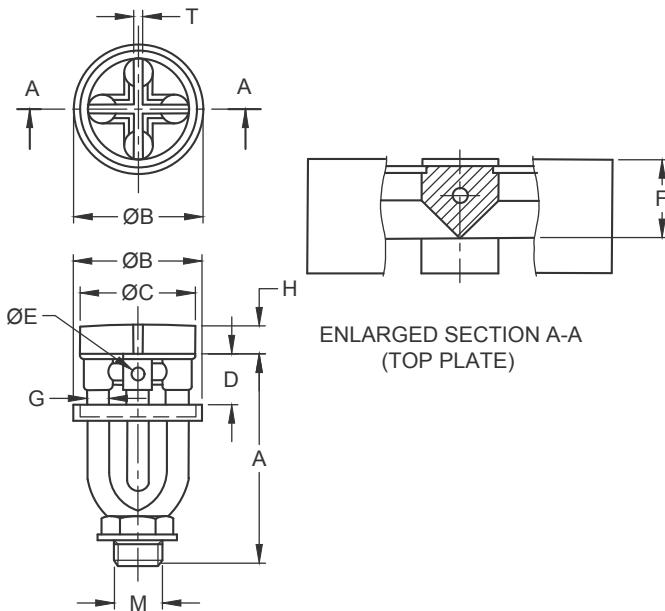


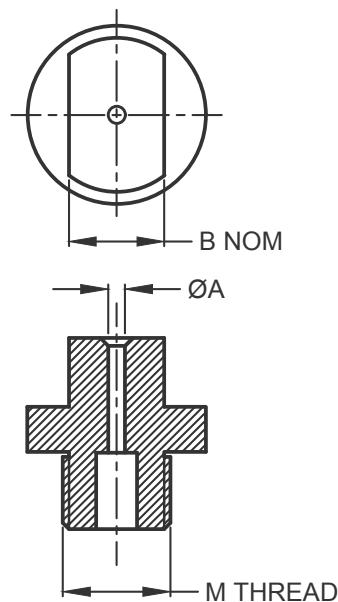
FIG. 1B BURNER, ROARER TYPE FOR OIL PRESSURE HEATER

4

Sl No.	Oil Pressure Heater		Dimensions				E Hole Dia (Optional)	F	Thread (Medium Fit)	Diameter <sup>1)</sup> of Fuel Feed Pipe	Thickness of Burner Ring	Thickness <sup>2)</sup> of Fuel Feed Pipe	Dimensions of Hex (Across Fiats $\pm 0.5$ )	Fin Height	Fin Thickness Approx	Mass of Burner (g) Min
	Heater Designation	Burner Designation	A	B	C	D										
			$\pm 1$	$\pm 1$	$\pm 1$											
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
i)		1H	60	44	38	$21 \pm 1$	4.5	9	M14.5 $\times$ 0.75	8 $\pm 0.08$	0.75	0.8 $\pm 0.10$	19	-	-	90
ii)	As per IS 2787 for 1 and multi-burners	2H	73	55	15	$23 \pm 1$	5.5	10	M14.5 $\times$ 0.75	9 $\pm 0.03$	0.95	1.0 $\pm 0.12$	19	-	-	120
iii)		3H	100	73	58	$44 \pm 1$	6.0	16	M17 $\times$ 1.00	10 $\pm 0.1$	1.00	1.14 $\pm 0.15$	22	15	2.5	250
iv)		4H	120	85	68	$49 \pm 1$	6.5	19	M17 $\times$ 1.00	11 $\pm 0.1$	1.12	1.14 $\pm 0.15$	22	18	3.0	400

<sup>1)</sup> Refer to IS 5493 for details.<sup>2)</sup> Fin may be either integral or separately brazed. Therefore dimensions H and T are only approximate.

All dimensions in millimetre unless otherwise specified.

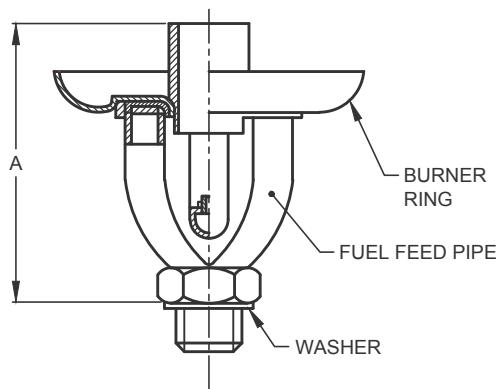


Sl No.	Burner Designation for Stove	Burner Designation of Oil Pressure Heaters	Dia <sup>1)</sup> 'A' mm	B $\pm 0.5$ mm	Thread <sup>2)</sup>
(1)	(2)	(3)	(4)	(5)	(6)
i)	1	-	0.30	3.75	M 4.5 × 0.5
ii)	0,1S,2S	1H	0.35	3.75	M 4.5 × 0.5
iii)	2	2H	0.40	3.75	M 4.5 × 0.5
iv)	3S	-	0.40	5.00	M 6 × 0.75
v)	3	3H	0.57	5.00	M 6 × 0.75
vi)	4	4H	0.75	5.00	M 6 × 0.75

<sup>1)</sup> Optional, for guidance only

<sup>2)</sup> Medium class in accordance with IS 4218 (Part 4)

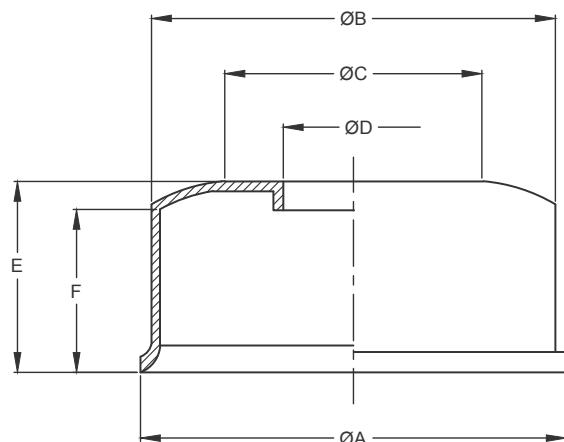
FIG. 2 NIPPLE



3A BURNER DETAIL, SILENCER TYPE

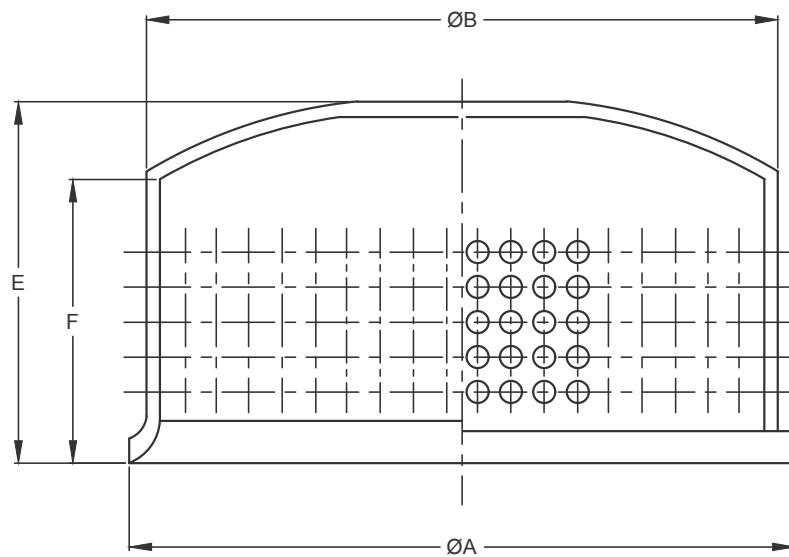
Sl No.	Stove Designation		Burner Designation	Height A	Thread Medium Fit $M$	Outside <sup>1)</sup> Dia of Fuel Feed Pipe	Thickness of Fuel Feed Pipe	Thickness of Burner Ring	Dimensions Across Flats of Hexagonal Nut, mm $\pm 0.5$
	New Designation	Earlier Designation							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	0S, 1S	5 and 105	0S, 1S	65 $^{+0}_{-2.0}$	M14.5 $\times$ 0.75	8.0	0.80 $\pm 0.10$	0.95	19.0
ii)	2S	2S	2S	78.5 $^{+0}_{-2.0}$	M14.5 $\times$ 0.75	9.0	1.00 $\pm 0.12$	1.15	19.0
iii)	3S	3S	3S	93.0 $^{+0}_{-5.0}$	M17 $\times$ 1	10.0	1.14 $\pm 0.15$	1.50	22.0

<sup>1)</sup> See IS 5493 for details



3B INNER CAP FOR SILENCER TYPE BURNER

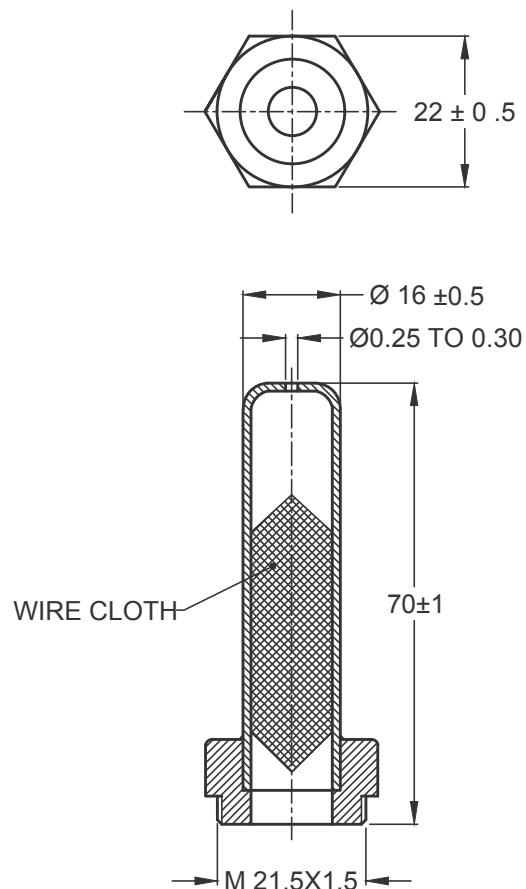
Sl No.	Stove Designation		Burner Designation	Dia A	Dia B	Dia C	Dia D	E	F
	New Designation	Existing Designation							
(1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	0S, 1S	5 and 105	0S, 1S	41	40	30	16.5	16	14
ii)	2S	2S	2S	46	44	32	17.0	19.0	17
iii)	3S	3S	3S	59	56	40	19.5	24.5	20



3C OUTER CAP FOR SILENCER TYPE BURNER

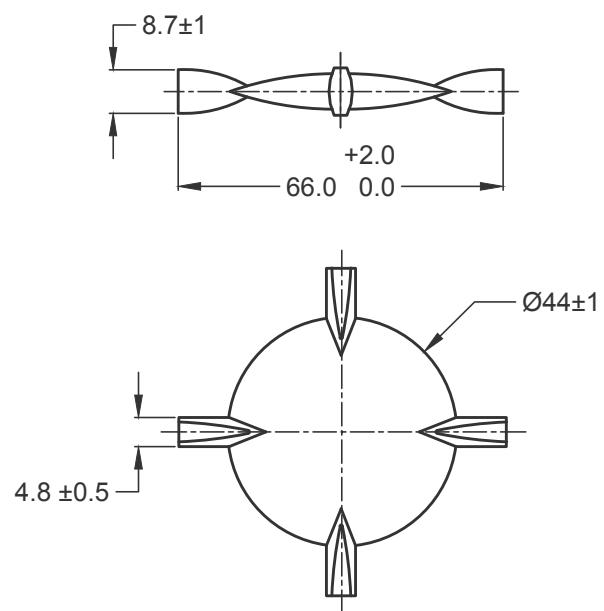
Sl No.	Stove Designation		Burner Designation	Dia A	Dia B	Dia				
	New Designation	Existing Designation				E	F			
						mm	mm			
				±0.5	±0.5	±0.5	±0.5			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)			
i)	0S, 1S	5 and 105	OS, 1S	47	44.0	24	20			
ii)	2S	2S	2S	51	48.5	27	22			
iii)	3S	3S	3S	63	62.0	37	30			

FIG. 3 SILENCER TYPE BURNER



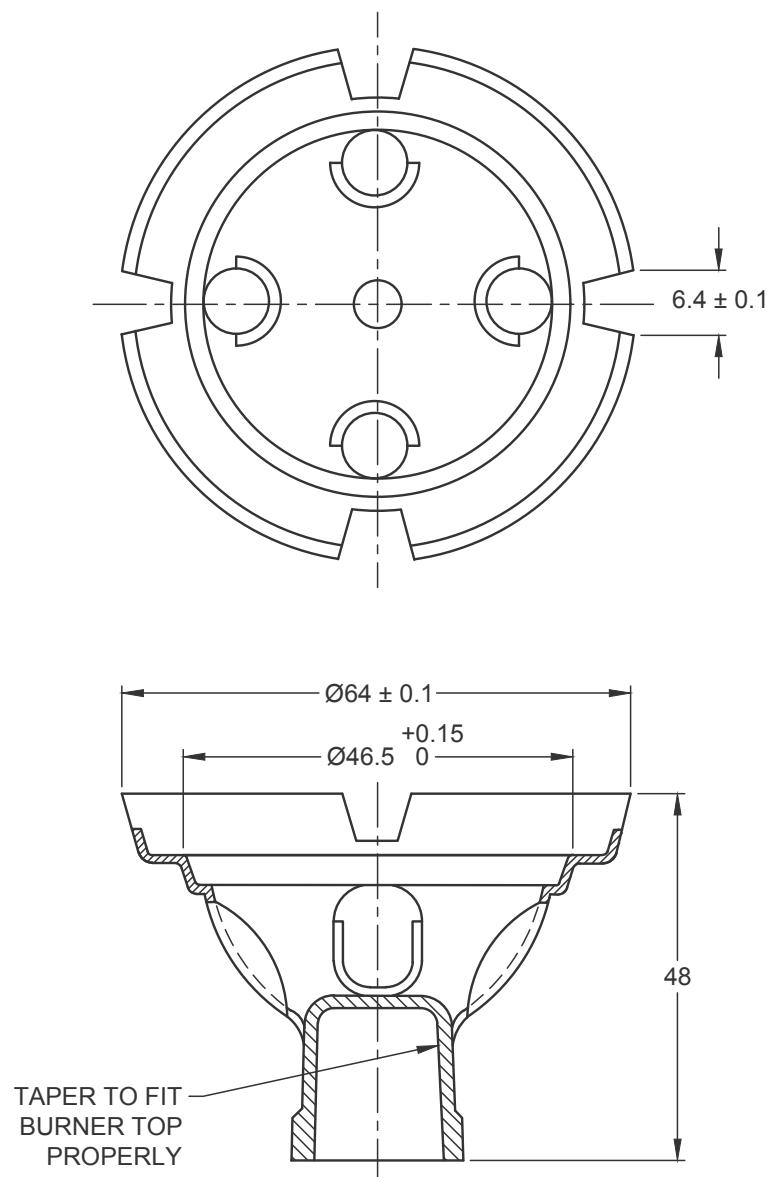
All dimensions in millimeters.

FIG 4. BRUNER FOR STOVE No. 100



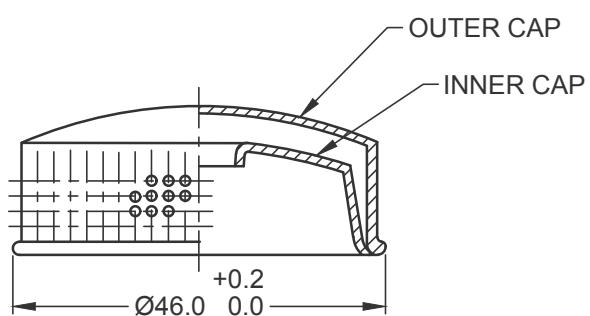
All dimensions in millimeters.

FIG 5. BRUNER PLATE



All dimensions in millimeters.

FIG 6. BRUNERHEAD



All dimensions in millimeters.

FIG 7. SILENCER FOR TUBE BURNER

## 8 FINISH

The burner and its various components shall be finished smooth and free from burrs, sharp edges and any other manufacturing defects. Residues of solder flux and similar corrosives shall be removed during manufacture to prevent later corrosion.

## 9 SAMPLING

Sampling and acceptance criteria for burners shall be as agreed to between the purchaser and the supplier. A recommended scheme for the same is given in Annex B.

## 10 TESTS

### 10.1 Pressure Tests

#### 10.1.1 Maximum Working Pressure Test

Each burner shall be subjected to an air pressure of  $250 \text{ kN/m}^2$  (2.5 kgf/cm $^2$  approx.) with the outlet blocked. It shall not show any sign of leakage at the joints.

#### 10.1.2 Safety Pressure Test

The burner shall be subjected to an internal hydraulic pressure of  $600 \text{ kN/m}^2$  (6 kgf/cm $^2$  approx.) for a period of 10 min. The burner shall not show any sign of leakage or any appreciable deformation.

#### 10.1.3 Bursting Pressure Test

When the burner selected in 10.1.2 is further subjected to a hydraulic pressure of  $1000 \text{ kN/m}^2$  (10 kgf/cm $^2$  approx.), it shall neither burst nor be unduly distorted. Slight leakage of the hydraulic fluid shall, however, be permissible, provided the pressure is capable of being maintained for duration of not less than 5 min.

### 10.2 Tests for Thermal Efficiency

When tested in accordance with the method described in Annex C, thermal efficiency of the burner shall not be less than:

- a) 55 percent for roarer and tube type burner, and
- b) 58 percent for silencer type burner.

**10.2.1** Thermal efficiency may be declared, if it is more than 60 percent for roarer type burner and 62 percent for silencer type burner.

## 10.3 Fuel Consumption

Each burner when fitted to the stove of corresponding designation shall give within  $\pm 15$  percent of manufacturer's specified fuel consumption in g/h.

## 11 MARKING

**11.1** Each burner shall be marked with the following on packages containing the burners with stickers/printing:

- a) Designation of the stove along with which it is to be used;
- b) Name or recognized trade-mark of the manufacturer; and
- c) Rate of fuel consumption in g/h with a tolerance of  $\pm 15$  percent.

### 11.2 BIS Certification Marking

The burner may also be marked with the Standard Mark, along with which it is to be mentioned 'for burner only'.

**11.2.1** The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

## 12 PACKING

Each burner together with its components shall be wrapped in a moisture-proof paper and then packed in a thick paper pack. It may also be packed as agreed to between the purchaser and the supplier.

**ANNEX A**( *Clause 2* )**LIST OF REFERRED INDIAN STANDARDS**

<i>IS No.</i>	<i>Title</i>
210 : 2009	Grey iron castings — Specification ( <i>fifth revision</i> )
292 : 1983	Specification for Leaded brass ingots and castings ( <i>second revision</i> )
319 : 2007	Free cutting brass bars, rods and sections—Specification ( <i>fifth revision</i> )
407 : 1981	Specification for brass tubes for general purposes ( <i>third revision</i> )
410 : 1977	Specification for cold-rolled brass sheet, strip and foil ( <i>third revision</i> )
513 (Part 1 and 2) : 2016	Cold reduced low carbon steel sheet and strip ( <i>fifth revision</i> )
1079 : 2017	Hot rolled carbon steel sheet, plate and strip — Specification ( <i>seventh revision</i> )
1342 : 2002	Oil pressure stoves — Specification ( <i>sixth revision</i> )
1459 : 2018	Kerosene — Specification ( <i>fourth revision</i> )
1568 : 1970	Specification for wire cloth for general purposes ( <i>first revision</i> )
1570 (Part 5) : 1985	Schedules for wrought steels: Part 5 Stainless and heat resisting steels ( <i>second revision</i> )
2283 : 2000	Nickel silver sheet, strip and foil— Specification ( <i>second revision</i> )
2501 : 1995	Solid drawn copper tubes for general engineering purposes — Specification ( <i>third Revision</i> )
2787 : 2006	Oil pressure heaters— Specification ( <i>third revision</i> )
4218 (Part 4) : 2001	ISO general purpose metric screw threads : Part 4Selected sizes for screws, bolts and nuts ( <i>second revision</i> )
4905 : 2015	Random sampling and randomization procedures ( <i>first revision</i> )
5493 : 1981	Dimensions for wrought copper and copper alloy tubes ( <i>first revision</i> )
6912 : 2005	Copper and copper alloys forging stock and forging ( <i>second revision</i> )
8119 : 1976	Specification for copper brazed steel tubing

## ANNEX B

( Clause 9 )

## SAMPLING SCHEME AND CRITERIA FOR CONFORMITYFOR BURNERS

**B-1 LOT**

**B-1.1** In any consignment, all the burners of the same designation, type, shape, size and manufactured from same materials under essentially similar conditions of production, shall be grouped together to constitute a lot.

**B-1.1.1** Each lot shall be inspected separately to ascertain its conformity or otherwise to the requirements of this specification.

**B-2 SELECTION OF SAMPLES**

**B-2.1** The number of burners to be selected for the sample from a lot, shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table 1.

**B-2.2** The burners to be selected for the sample from a lot shall be chosen at random and in order to ensure the randomness of selection, IS 4905 shall be followed.

**B-3 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY****B-3.1 Inspection for Shape, Size, Dimensions, Construction and Finish**

All the burners selected according to **B-2.1** and col 2 of Table 1 shall first be inspected for shape, size, dimensions, construction and finish. Any burner failing in any one or more of the above characteristics shall be considered as defective. The lot shall be considered as conforming to the requirements of these characteristics if the number of defective burners obtained in the sample does not exceed the permissible number of defectives given in col 3 of Table 1.

**B-3.2 Testing for Maximum Working Pressure**

The burners in the sample having passed the requirements of **B-3.1** shall be subjected to maximum

working pressure test (see **10.1.1**). The lot shall be considered as conforming to the requirements of maximum working pressure test only if the number of burners failing in this test does not exceed the corresponding permissible number of defectives given in col 3 of Table 1.

**B-3.3 Testing for Safety Pressure and Bursting Pressure**

From the stoves inspected/tested under **B-3.2** and found conforming to the requirements of above-mentioned characteristics, a sub-sample of the size given in col 4 of Table 1 shall be selected at random and subjected to the safety pressure test and subsequently to the bursting pressure test in accordance with **10.1.2** and **10.1.3**. A stove failing to satisfy either safety pressure test or bursting pressure test or both shall be considered as defective. The lot shall be declared as conforming to the requirements of safety pressure and bursting pressure if the number of defective stoves as obtained above does not exceed the permissible number of defectives given in col 5 of Table 1.

**B-3.4 Testing for Thermal Efficiency**

From the burners inspected/tested under **B-3.1** and **B-3.2** and found conforming to the requirements of the above mentioned characteristics, a sub-sample of the size given in col 4 of Table 1 shall be selected at random and subjected to thermal efficiency test (see **10.2**). A burner failing to meet the requirements of thermal efficiency test shall be considered as defective. The lot shall be considered as conforming to the requirements of thermal efficiency test, only if the number of defective burners as obtained above does not exceed the permissible number of defective given in col 5 of Table 1.

**Table 1 Sample Size and Criteria for Conformity**

( Clauses B-2.1, B-3.1, B-3.2, B-3.3 and B-3.4 )

Sl No.	No. of Burners in the Lot	No. of Burners to be Selected in the Sample	Permissible Number of Defective Burners	Sub-Sample Size	Permissible Number of Defectives in the Sub-Sample
(1)	(2)	(3)	(4)	(5)	(6)
i)	Up to 150	20	0	5	0
ii)	151 to 300	32	1	8	0
iii)	301 to 500	50	2	13	0
iv)	501 to 1000	80	3	20	0
v)	1001 to 3000	125	5	32	1
vi)	3001 and above	200	7	50	2

## ANNEX C

( Clause 10.2 )

## TEST FOR THERMAL EFFICIENCY

**C-1 THERMAL EFFICIENCY**

Thermal efficiency may be defined as the ratio of heat actually utilized to the heat theoretically produced by complete combustion of a given quality of fuel (which is based on the net calorific value of the fuel).

**C-2 CONDITIONS FOR CARRYING OUT THERMAL EFFICIENCY TEST****C-2.1 Test Room Conditions**

**C-2.1.1** The air of the test room shall be free from draughts likely to affect the performance of the stove. The initial temperature of the room shall be between 25 to 30°C.

**C-2.1.2** At the start of the test, the stove and the kerosene in its container shall be at room temperature.

**C-2.2 Test Kerosene**

The kerosene used shall be as available from the market. However, in the case of dispute the testing shall be done with kerosene confirming to IS 1459.

**C-2.3 Setting of the Stove**

The burner whose efficiency is to be determined shall be fitted properly into the stove of corresponding designation with 15 to 30 mm clearance, between the bottom of the vessel and top of the burner as declared by the manufacturer. Prior to the performance tests the stove shall be checked and examined to ensure that all components are undamaged and are properly assembled according to the manufacturer's instructions. The stove shall be lighted and allowed to burn for a period of 10 min at a working pressure 100 to 200 kN/m<sup>2</sup> (1 to 2 kgf/cm<sup>2</sup> approx) during which a blue flame shall be obtained. Now a vessel containing water shall be placed on the stove and the pressure shall be readjusted to get a maximum blue and stable flame.

In the manner prescribed above, the stove shall be operated at the maximum blue flame height for two periods of approximately two hours each during which it shall be observed for any abnormal performance or leakage. This test may be done in draught free room.

**C-3 METHOD OF TEST****C-3.1 Fuel Consumption Test**

The burner whose efficiency is to be determined shall be fitted properly into the stove of corresponding designation. The stove shall be fitted with kerosene up to three-fourths of its capacity. The stoves shall be

lighted and brought up to the working pressure as given below:

SI No.	Stove Designation		Working Pressure
(1)	(2)	(3)	(4)
i)	New Designation	Existing Designation	kgf/cm <sup>2</sup>
ii)	OOR, OOS, OTR, OTS, 1R, 1S	100, 101, 105, 140 105, 140, 1.5, 11 and 5F	1.4
iii)	H.R, 1LS, 2R, 2S, 3R, 3S	2, 2S, 3, 3S	2.0

After burning for 5 min, the lighted stove is weighed on a sensitive balance with an accuracy of one gram. The stove shall be allowed to burn for one hour with an aluminium vessel having sufficient water in it. At the end of one hour, weight of the burning stove shall be noted after removing the aluminium vessel. The difference in the initial and final weight of the burning stove shall give the kerosene consumption rate in g/h. Then suitable vessel for the corresponding fuel consumption rate shall be selected in accordance with Table 2 for determining the thermal efficiency.

**C-3.2** A cylindrical flat-bottomed aluminium vessel (selected according to fuel consumption rate as given in Table 2 read with **C-3.1**) provided with aluminium lid shall be used for this purpose. The lid shall have two holes, one for inserting the cork for holding a thermometer and the other for the stirrer (made of aluminium wire) required for stirring the water. The vessel along with the lid and stirrer shall be weighed first and then filled with the required amount of water (as in Table 2 read with **C-3.1**). The initial temperature of water shall be kept within  $\pm 2^\circ\text{C}$  from the actual room temperature. The fuel container of the stove shall be connected to a pressure gauge and the fuel container filled to nearly three-fourths of its capacity. The stove shall be lighted and an average working pressure for the corresponding stove as given in **C-3.1** shall be maintained. After burning the stove for 5 min, weight of the stove, time and initial temperature of the water ( $\pm 2^\circ\text{C}$  from the actual room temperature) in the vessel shall be noted. The vessel shall be covered with a lid fitted with a test quality mercury thermometer having an accuracy of  $0.5^\circ\text{C}$  inserted into the cork in such a way that the bulb of the thermometer dips into half the depth of the water in the vessel. The free end of the stirrer shall come out of the lid.

**C-3.3** The vessel shall be placed on the stove after initial weighing of the stove and the stop watch shall

be started immediately. Heat the water while stirring with the help of stirrer till it attains a temperature of  $90 \pm 1^\circ\text{C}$ . Note the time required to heat the water from initial temperature  $t_1$  ( $\pm 2^\circ\text{C}$  from the actual room temperature) to the final temperature,  $t_2$  ( $90 \pm 1^\circ\text{C}$ ), the stop watch shall then be stopped. The stove shall be weighed again after one hour of its previous weighing. The difference in the initial and the final weight of the burning stove shall give the kerosene consumption rate in g/h.

NOTE — Care shall be taken to ensure that the same average working pressure is maintained throughout the test and the water stirred gently during heating.

#### C-4 CALCULATIONS

Thermal efficiency shall be calculated as follows:

- Heat gained by vessel =  $W \times 0.214 (t_2 - t_1)$  kcal
- Heat utilized for heating water =  $w \times 1 \times (t_2 - t_1)$  kcal
- Total heat utilized =  $(W \times 0.214 + w) (t_2 - t_1)$  kcal
- Heat produced by fuel =  $\frac{X \times T \times 10500}{60}$  kcal

e) Thermal efficiency, percent

$$= \frac{\text{Heat Utilized}}{\text{Heat Produced}} \text{ kcal} \times 100$$

$$= \frac{(W \times 0.214 + w)(t_2 - t_1)}{X \times T \times 10500} \times 60 \times 100$$

Where,

$W$  = weight in kilogram, of the vessel complete with lid and stirrer;

$w$  = weight in kg, of the water;

$t_1$  = initial temperature of water, in  $^\circ\text{C}$ ;

$t_2$  = final temperature of water, in  $^\circ\text{C}$ ;

$X$  = weight in kilogram, of fuel consumed in one hour; and

$T$  = time in minutes, taken to heat the water to  $t_2$   $^\circ\text{C}$ .

NOTE — Specific heat of aluminium, is 0.214, net calorific value of fuel is 10 500 kcal/kg.

**Table 2 Aluminium Vessels for Thermal Efficiency Test**  
( Clause C-3.1 )

Sl No.	Fuel Consumption Rate, g/h At Thermal Efficiency Test Pressure	Vessel Diameter (External) Mm ( $\pm 5$ Percent)	Vessel Height (External) Mm ( $\pm 5$ Percent)	Total Weight With Lid G ( $\pm 10$ Percent)	Weight Of Water In Vessel Kg
(1)	(2)	(3)	(4)	(5)	(6)
i)	151 - 180	245	130	632	4.8
ii)	181 - 200	260	140	750	6.1
iii)	201 - 240	285	155	853	7.7
iv)	241 - 270	295	165	920	9.4
v)	271 - 300	320	175	1 100	11.4
vi)	301 - 330	340	185	1 200	12.50
vii)	331 - 360	350	195	1 310	14.00
viii)	361 - 390	370	200	1 420	16.00
ix)	391 - 420	380	210	1 530	18.00
x)	421 - 450	400	215	1 640	20.00
xi)	451 - 480	410	225	1 750	22.00
xii)	481 - 510	420	230	1 860	24.00
xiii)	511 - 540	435	240	2 000	26.50
xiv)	541 - 570	450	245	2 130	29.00
xv)	571 - 600	460	250	2 240	31.00
xvi)	601 - 630	470	255	2 320	33.00
xvii)	631 - 660	480	260	2 440	35.00
xviii)	661 - 700	490	265	2 520	38.00
xix)	701 - 750	500	270	2 650	41.00
xx)	751 - 800	510	275	2 720	44.00
xxi)	801 - 850	530	280	3 050	47.00
xxii)	851 - 900	540	285	3 190	50.00
xxiii)	901 - 950	550	290	3 330	53.00
xxiv)	951 - 1 000	560	300	3 480	57.00



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